Research White Paper
SmartyAnts Reading World

Meeting the Needs of English Language Learners

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ADDRESSING THE NEEDS OF ENGLISH LANGUAGE LEARNERS (ELLs) WITH SMARTYANTS

Introduction

Any discussion on English Language Learners (ELLs) in the United States will conjure up varied reactions from teachers, parents, and the public alike. Changing immigration patterns as well as demographic shifts in the United States over the last thirty years has dramatically altered the population in public schools. According to the National Center for Education Statistics, "the number of school-age children who spoke a language other than English at home rose from 4.7 to 11.2 million between 1980 and 2009, or from 10 to 21 percent of the population in this age range" (NCES, 2011).

This shift alone has resulted in a proliferation of services and settings for ELLs in schools, especially in states with high populations of ELLs in the school system. Yet, school-age children who speak a language other than English at home and speak English with difficulty remains around 5 % (NCES, 2011). For these students, a short window of opportunity exists for early intervention during childhood to prevent later language and reading delays (Verhoeven, 2011). Over time, without remediation, less than 20% of children learning English in schools meet state standards for reading (Kindler, 2002). Although the phrase "English language learner" can technically refer to any person learning English at any stage in life, for the purposes of this literature review, it refers to K–12 students enrolled in U.S. schools. Garcia (2009) defines ELLs as:

> *Students 3–21 years old who are enrolled in elementary or secondary school but who do not speak, read, write, or understand English well enough to either (1) reach a proficient level on state achievement tests, (2) be successful in a classroom in which English is the language of instruction, or (3) fully participate in society. (p. 1)*

These students are sometimes also referred to as Limited English Proficient (LEP) students, although ELL is often preferred, as LEP emphasizes a deficiency in the students as opposed to the overall process of learning. The process by which ELL students learn English is called second language acquisition, or second language learning. Most ELLs enter school already having acquired the majority, though not necessarily all, of the basic components of their native language or languages (Ballantyne, 2008). The phrase second language acquisition still applies even if the student is technically learning English as a third language or beyond.

Unfortunately, technology-based reading interventions have yet to play a major role in remediating the difficulties ELLs face when going into the classroom for the first time. Programs like SmartyAnts, designed to teach early reading skills to prekindergarten to second-grade students, present a unique opportunity to remediate early reading deficits through scaffolded and responsive instruction, with the option of that instruction being in the ELL's first language. But how does SmartyAnts meet the needs of English language

learners? Organized by blending the suggestions of a variety of researchers, including: Butler-Pascoe & Wiburg, 2003; Cummins, 2007; Díaz-Rico & Weed, 2010; Dukes, 2005; Van Scoter & Boss, 2002; Ybarra & Green, 2003; and Zehr, 2007, this review of relevant research related to technology and early literacy instruction for English language learners focuses on learning, instruction, and assessment. Also prior to explaining specific aspects of the domains in their model, an outline of some of the context for learning English as a second language is discussed.

The Development of SmartyAnts

SmartyAnts targets the needs of all struggling readers. Its research-based curriculum and pedagogy were created under the advisement of a core team of educators from Stanford University and the University of California, Berkeley:

- Dr. P. David Pearson, world-renowned reading researcher, professor, and dean emeritus of the University of California, Berkeley, Graduate School of Education.

- Dr. Robert Calfee, distinguished professor emeritus of the Stanford University School of Education, and dean emeritus of the University of California, Riverside, Graduate School of Education.

- Dr. Mia Callahan, graduate of Stanford University and University of California, Berkeley, and seasoned reading teacher of 30+ years.

- The designers of SmartyAnts employed the findings of landmark intervention studies to create the program: Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998; Vellutino, Scanlon, Sipay, Small, Pratt, Chen, et al., 1996; Vellutino, Scanlon, & Jaccard, 2003; Torgesen, Wagner, Rashotte, Rose, Lindamood, Conway, et al., 1999, and the most influential national research studies of the past 50 years such as: Bond & Dykstra, 1967; Chall, 1967; Anderson, Hiebert, Scott, & Wilkinson, 1985; Adams, 1990; Snow, Burns, & Griffin, 1998; NICHD, 2000.

Pre-conditions for Learning English

When ELLs enter the school system many have had little exposure to English as the primary language of communication. Normally all that may be expected from these students is that they have heard English on television, over the internet, or in brief conversations outside of the home (Verhoeven, 2011). Since early language abilities are largely determined by a child's oral language fluency, ELLs arrive at school at a distinct disadvantage.

When linguists speak of language acquisition, it is understood that they are referring to children acquiring their first language. There is a long history of debate surrounding issues of (first) language acquisition, that is, how children come to speak in their mother tongue in such a seemingly effortless manner. One early explanation for language acquisition was offered by behaviorists, most notably B.F. Skinner, who argued that linguistic behavior is molded solely by the environment, namely adult speakers whose speech children imitate (Skinner, 1957). Behaviorists further believed that children are externally reinforced by adult speakers who correct them when they are "wrong"

and reward them when they are "right" (Akmajian, Demers, Farmer, & Harnish, 1995). Clearly, this simplified theory could not explain the vast number of utterances that children produce that they in fact have never heard before. Furthermore, there is no considerable empirical evidence to support the argument that correcting children's grammar plays any role in acquisition (Borer, 1998). This theory was most successfully challenged by Noam Chomsky's innateness hypothesis, which proposed that children are born with the biological predisposition for language acquisition (Chomsky, 1986). Chomsky points out that "the language each person acquires is a rich and complex construction hopelessly underdetermined by the fragmentary evidence available [to the child]. Nevertheless, individuals in a speech community have developed essentially the same language" (Pinker, 1994, p. 23). Chomsky's theories addressed the "input problem," i.e., the evidence of a language available to a child underdetermines the acquired grammar for that language. Input alone cannot explain language acquisition, although it maintains a central role in the process of language acquisition. Ballantyne (2008) points out "research shows that first language acquisition continues into the elementary school years. Children entering elementary school may not yet have acquired the complex grammatical structures of their first language" (p. 9).

A central question is whether second language acquisition follows the same pattern as first language acquisition. This question stems from the same issue that surrounds first language acquisition, i.e., how can a speaker of a second language come to produce utterances that he or she could not have possibly learned before?

Numerous studies have considered the possibility that second language acquisition follows the same process that Chomsky proposed for first language acquisition (Cook, 1985; White, 1989), a proposal that is still debated. Ludo Verhoeven (2011) describes the processes of first language and second language acquisition as parallel, with the abilities of a student in a second language to be highly dependent on the development of abilities in the first language. In fact, too much focus on the second language may be detrimental to the development of early skills in language and literacy (Tabors, 1997; Dickinson & Tabors, 2002).

Education research consistently emphasizes that such linguistic input for English language learners must be engaging and draw the student in for maximum language learning (Gersten, 2003; Goldenberg, 2008). With this background knowledge and definition of terms, we begin to outline how SmartyAnts provides engaging and highly interactive English language input for students at all levels of English language learning.

Learning through Best Practices for Technology and English Language Learners

According to Dukes (2005), best practices is defined as "a technique or methodology that, through experience and research, has proven to reliably lead to a desired result" (p. 3). Although research on the effectiveness of technology for English language learners is in its infancy, there is already a body of research outlining some of the best practices in utilizing technology for teaching English language

skills and reading skills to all students, in particular English language learners (Butler-Pascoe & Wiburg, 2003; Cummins, 2007; Dukes, 2005; Van Scoter & Boss, 2002; Ybarra & Green, 2003; Zehr, 2007). This section outlines specific best practices for integrating technology and teaching English language learners, and looking at how SmartyAnts supports these best practices.

Develop and Practice the Key Components of Reading

It is fairly well understood and accepted that learning a second language requires many of the same reading skills that are involved in learning a first language, including phonemic awareness, phonics, vocabulary, and comprehension (Díaz-Rico & Weed, 2010). The use of a computer program that is tailored to the specific learning needs of the student is an unobtrusive, nonjudgmental, and potentially high impact way of providing instruction to these students. In the following three subsections, a review of basic approaches to how SmartyAnts targets phonemic awareness and phonics, vocabulary, and comprehension is provided.

Phonemic Awareness and Phonics

Referred to as phonemic awareness,the ability to isolate sounds represents the "metalinguistic understanding that spoken words can be decomposed into phonological primitives, which in turn can be represented by alphabetic characters" (Pugh, Sandak, Frost, Moore, & Mencl, 2006, p. 65). Phonemic awareness is typically learned only in a classroom environment (Snow, Burns, & Griffin,1998). SmartyAnts presents the opportunity to learn phonemic awareness in a child's second language at home—exposing the child early to a critical skill to later reading gains. Typically the sounds of letters, as well as letter combinations like digraphs, diphthongs and blends, also are taught in school in the form of phonics instruction.

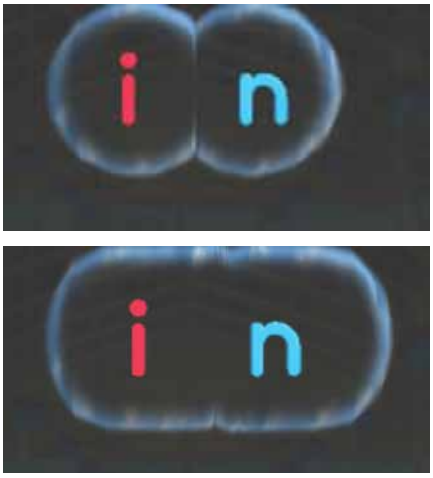

Figure 1: Word bubbles illustrating the process of sounding out and blending phonemes to create words

In a game such as Four Square, the child playing the game will be given the opportunity to identify letters. Then the letters' relationship to a word illustrated on the screen above will be shown with each phoneme segmented both aurally and visually for the child to see. The visual segmentation occurs through the use of a word bubble that expands as the phoneme segments are then blended and pronounced as part of a word.

This technique corresponds to a popular instructional strategy called sound boxes. Sound boxes, just like many other strategies of breaking down phonemes in words, emphasize the individual phonemes as well as the putting of sounds together, or blending. Preliminary research has shown that the systematic use of sound boxes or

phonemic segmentation has positive effects on developing phonemic awareness (McCarthy, 2008; Yeh & Connell, 2008).

Another way that phonemic awareness is explicitly taught in SmartyAnts is through the use of rhymes, a technique supported by teachers of ELLs (Díaz-Rico & Weed, 2010). Because traditional rhyming games require an understanding of how to manipulate sounds in words, they can be effective in teaching simple manipulation of phonemes. Research suggests that due to the complex nature of developing a tiered curriculum in many classrooms on phonemic awareness (McGee & Ukrainetz, 2009), computer-based programs may be one of the best ways of developing mastery in this area.

Vocabulary

Words are not taught in isolation from their contexts or meanings and must be used in context for ELLs to develop rich vocabularies. According to Lynn Díaz-Rico and Kathryn Weed (2010), "Native English speakers typically know at least 5,000-7,000 English words before kindergarten—a huge vocabulary as anyone who has struggled to learn a second language knows." In order for ELLs to even keep pace with their English-speaking peers they need to learn at least that many words upon arrival if not before kindergarten begins.

The explicit teaching of vocabulary cannot happen early enough for students. Important studies such as those conducted by Hart and Risley (1995) clearly outline how early deficits in word knowledge become compounded overtime, leaving children far behind their higher achieving peers. Part of developing a robust vocabulary includes learning the most common words early on while also learning uncommon or academic words (Beck, McKeown, & Kucan, 2002).

SmartyAnts teaches word recognition initially through phonemic awareness activities and later moves into learning words through word games incorporating sound/symbol correspondences (phonics) and practice reading the words in longer stories. As students master the words normally by identifying them correctly at least three times, they accumulate the words in the reward room. Here students can see which words they have mastered as well as ones they are still working on. When the words are clicked on, they are segmented and pronounced. This dynamic word wall style presentation corresponds to well-known practices for enriching vocabulary instruction because it often organizes the words into families, morphological categories, and/or phonetic categories depending on the level of the student (Beck & McKeown, 2007).

Comprehension

Developing a deep understanding of what is read comes about through a complex set of cognitive processes and through fluency with a variety of reading-related cognitive tasks. Early on, however, generally teaching reading comprehension stresses recall, sequencing, predicting, and summarizing as requisite skills of reading comprehension (Snow, Burns, & Griffin, 1998).

In SmartyAnts, the Story Quiz Show, which is accessible after completing a variety of games on the activity board, is the main site of reading comprehension activities. A variety of questions asked in a game show-like format allow the child

Figure 2: Story Game Show where questions about the stories provide clues to early reading comprehension skills

to demonstrate mastery of a library of stories that are read prior to the game show beginning. Metacognitive thinking strategies are modeled throughout both by the host of the show and the ant friends that the child invites to play along and react to the story (Harvey & Goudvis, 2007). Moreover, the stories that are read to the child normally have vivid illustrations that depict the story. The presence of these illustrations also increases the comprehensibility of the text.

Increase Comprehensibility Generally

Dukes (2005) notes that "increasing comprehensibility in the classroom means using whatever appropriate means necessary to ensure that students understand the material presented to them" (p. 3). This does not necessarily mean oversimplifying the language for English language learners, rather, using outside sources to get the

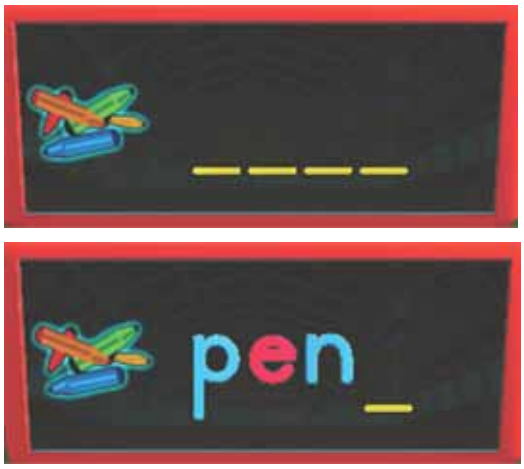

Figure 3: An example of a visual support provided when the user is asked to produce the word pens

meaning across to them. Garcia (2009) specifies that teachers should provide "context" to help students understand the content: "In order to make the content more comprehensible, teachers can use a variety of scaffolding techniques, such as… using a number of visual supports, such as objects, pictures, video images…" (p. 16). SmartyAnts has a number of visual supports built into its program, by which students see pictures of the objects that go with the words they are building or putting together into stories that they are writing.

Figure 4: The Assessment Pool is the pre-assessment that places children in an appropriately leveled learning environment.

At the same time, SmartyAnts still challenges students and uses positive reinforcement as it pushes them to continue to move up through all 69 lessons and 11 levels that

it provides. Both Stephen Krashen and Vygotsky noted the ability and need of students to push beyond their level of competence; that is, students need comprehensible input that still challenges their abilities (Hobgood, 2005). SmartyAnts has addressed this need. Students will always strive to push ahead and move up in each level of the program. The large variety of different activities also provides them with a variety of comprehensible input, by presenting the material in different venues.

Figure 5: The Activity Board where the user selects from a variety of activities based on his or her interests

Provide Individualized Practice to Accommodate a Variety of Learning Styles and Levels

Assessment in SmartyAnts follows many of the recommendations made by leading theorists on early literacy for ELLs (Díaz-Rico & Weed, 2010). First, SmartyAnts does not assume that students know anything about sound–letter correspondence or English orthography as they begin their work. Through an interactive assessment, the user demonstrates their skills in a variety of domains of reading and is then placed in the appropriately leveled lesson where he or she begins the program. The assessment takes the form of a swimming pool where the user is asked to click on the letter based on name or sound. Then based on the number of times he or she gets that correct, is given a simpler or more complex task [Fig.4].

Then the user is placed into an interactive environment where he or she can choose from a variety of games which, targeting the same skill, aim to appeal to a variety of interests. This element of choice also helps students remain motivated while moving through the program since no one form of practicing a specific skill is required [Fig. 5].

Provide Multisensory Support

Using more than one sense to learn basic reading skills in English allows for students who may need additional input to learn the word to gain access to sounds, words, and texts which may be unfamiliar (Birsh, 2005; Díaz-Rico & Weed, 2010). The immersive environment of SmartyAnts brings life to the process of learning to read. Throughout the program directions for all activities are given orally and examples enacted by the Flea character provide auditory and visual support. All of the sounds, words, and texts learned are seen and heard multiple times. Touch is incorporated through the use of a computer mouse or its equivalent with activities such as painting letters to learn letter formation.

Create a Motivating and Positive Working Environment

Butler-Pascoe and Wilburg (2003) point out that "technology can aid teachers in creating a supportive, nonthreatening learning environment in which second language learners feel secure enough to practice the target language and to make and correct their own errors without embarrassment or anxiety" (p. 86). From the moment students get into the SmartyAnts world to be assessed, it is clear that it is a fun, engaging, and interactive world for students to join. The positive reinforcement that students receive is immediate in the form of the Coach, the user's Dog, and Flea, who support and accompany the student in his or her learning journey. This kind of motivating and positive working environment is crucial for all students, but especially for students such as English language learners, who feel more vulnerable and apprehensive in being assessed. There is never any negative feedback provided in SmartyAnts. For example, if Coach says "Click on the letter p, and the student instead clicks on a different letter, such as the letter v, instead of being told that he or she is "wrong," Coach says the letter v as a model. The student is not only corrected in a positive way, but he or she also learns something in the process, without ever being made to feel ashamed of answering incorrectly. This is especially important for ELLs who often already feel different from their native English speaking peers. Further, when students successfully complete any game while playing SmartyAnts, the next time they login they get a copy of The Daily Woof [Fig. 6] , which chronicles their accomplishments and reads them aloud to the user. The Daily Woof can also be sent to the email address of the registered parent or teacher of the game so that they remain informed as to the progress of their child and can support

Figure 6: The Daily Woof is one way to bridge home and school and keep concerned parents and teachers engaged with the learning games in Smarty Ants

him or her in any way possible. The involvement of family members in promoting early literacy or family literacy has long been a successful way of encouraging long-term gains in literacy (Hoover-Dempsey & Sandler, 1995; Lareau, 1989; Marvin & Wright, 1997).

The social and emotional support possible because of information like the Daily Woof connects the family, the school, and the child in a network of support. This email communication between family and instructors during the child's early learning potentially opens up discussions about the child's specific learning successes, especially if the parents have some understanding of spoken English.

Conclusion

As the English language learner population grows, it will soon become the majority of students in American public schools. Now is the time when

researchers and software developers should be working in tandem to design effective low-cost interventions that can support the life-long literacy achievement of ELLs. SmartyAnts Reading World successfully targets ELLs because it teaches early literacy skills; starts where children are; involves members of the family in the learning process; motivates children to learn; addresses different learning styles; and certainly engages students using more than one sense. More experimental research should be done to determine the degree of effectiveness this program has for ELLS though of this literature review clearly outlines how much potential this program has with this specific population.

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